Geophysical Research Abstracts,
Vol. 10, EGU2008-A-12421, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-12421
EGU General Assembly 2008

Tectonics, surface processes and the South American Low-Level Andean Jet: insights from stable isotopes and sedimentary environments

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The Puna of the southern central Andes comprises a high-elevation, semi-arid to arid low-relief region, which forms an integral part of the world's second largest orogenic plateau. Internally, the plateau is compartmentalized into sedimentary basins and intervening basement rages that were uplifted in a diachronous manner throughout the present plateau region, similar to ongoing deformation and uplift along the current plateau margin in the broken foreland. A unifying feature of the Puna-Altiplano plateau is that its location corresponds to sectors of the landscape in which channels have generally failed to incise deeply into basin sediments or through surrounding basement ranges. Importantly, in both areas the local base-level is hydrologically isolated from the foreland. This isolation occurs where the incising power of regional drainage systems has been greatly reduced due to a combination of diminished precipitation related to regional climate and local orography, and exposure of bedrock that is resistant to fluvial incision. This hydrologic isolation from the foreland restricts evacuation of eroded material, consequently leading to internal drainage and a reduction of relief between basins and the surrounding peaks. Thus, while a variety of deformation styles and possibly combinations of different processes may have generated

the high elevations and structural compartmentalization associated with the plateau, the low-relief character of the plateau may be a geomorphic, rather than a tectonic phenomenon. Basins similar to those in the Puna exist along the plateau margin, although these basins remain only transiently isolated and internally drained due to the proximity to high precipitation gradients which were established due to orographic barriers related to Pliocene uplift. These barriers focus precipitation and erosion and promote headward erosion, stream capture and ultimately basin exhumation and connection to the foreland, which prevents these areas to become incorporated into the plateau realm. The fact that humid environments exist at the eastern plateau margin seems paradoxical at these latitudes (22-27°S), as this region is inherently dry. New U-Pb chronostratigraphy on intercalated volcanic ashes in sediments exposed in the Subandes of Bolivia and analysis of paleosols in NW Argentina and Bolivia using stable C isotopes reveal that the onset of humid conditions along the eastern flanks of the southern central Andes was at approximately 8 Ma. We suggest that enhanced precipitation in this region was closely linked to the evolution of the Puna-Altiplano plateau and its adjacent eastern orographic barriers that forced the southward displacement of easterly moisture-bearing winds via the Low Level Andean Jet. In conclusion, by late Miocene time the orogenic system of the southern central Andes must have attained critical elevation thresholds to form an effective orographic barrier and rainfall originating from the dynamics of the South American Monsoon must have started to affect these latitudes.